

WHAT IS CLAIMED IS:

- 1        1.     A plasma reactor system for processing a substrate, the plasma reactor  
2           comprising:
  - 3                a processing chamber for containing a plasma, the plasma comprising at least  
4                one plasma product for processing the substrate;
  - 5                a gas inlet coupled to the processing chamber for providing gas to the  
6                processing chamber;
  - 7                a first power source;
  - 8                an induction coil, coupled to the first power source, to couple power from the  
9                first power source into the processing chamber to sustain the plasma;
  - 10              a plasma shaping member positioned within the processing chamber, the  
11                plasma shaping member having a recessed portion substantially above the center of  
12                the substrate and an extended portion outside the recessed portion; and
  - 13              a support for the substrate positioned such that the substrate is exposed to the  
14                at least one plasma product during processing.
- 1        2.     The reactor system of claim 1, wherein the material comprising the plasma  
2                shaping member is selected from the group consisting of quartz, silicon carbide,  
3                ceramic, and metal.
- 1        3.     The reactor system of claim 1, wherein the electrical potential of the plasma  
2                shaping member is floating relative to ground during processing of the substrate.
- 1        4.     The reactor system of claim 1, wherein the plasma shaping member is  
2                configured such that the recessed portion and the extended portion face the  
3                substrate.
- 1        5.     The reactor system of claim 1, wherein the outside diameter of the plasma  
2                shaping member ranges from 60 to 90 percent of the diameter of the substrate.
- 1        6.     The reactor system of claim 1, wherein a Z dimension of the plasma shaping  
2                member is greater than from about 10 to 15 percent of the outside dimension of the

3       plasma shaping member, and less than from about 25 to 30 percent of the outside  
4       dimension of the plasma shaping member.

1       7.       The reactor system of claim 1, wherein an X dimension and a Y dimension  
2       of the plasma shaping member are each between 0.3 and 0.5 inches.

1       8.       The reactor system of claim 1, wherein the sum of an X dimension and a Y  
2       dimension of the plasma shaping member are each as great as at least 10 percent of  
3       the height of the processing chamber.

1       9.       The reactor system of claim 1, wherein the plasma uniformity is better than  
2       about  $\pm 15$  percent.

1       10.      The reactor system of claim 1 further comprising a top wall of the processing  
2       chamber, and wherein the plasma shaping member is positioned adjacent to the top  
3       wall of the processing chamber.

1       11.      The reactor system of claim 1, further comprising a split Faraday shield.

1       12.      The reactor system of claim 1, further comprising a charged particle filter.

1       13.      The reactor system of claim 1, wherein the plasma shaping member is  
2       configured such that high temperature electrons are produced adjacent to the  
3       induction coil and are substantially blocked from diffusing toward the center of the  
4       processing chamber.

1       14.      The reactor system of claim 1, wherein the plasma shaping member provides  
2       a surface on which positive ions from the plasma and negatively charged species  
3       from the plasma may recombine.

1       15.      The reactor system of claim 1, wherein the uniformity of the ion flux to the  
2       substrate is better than  $\pm 15$  percent.

16. The reactor system of claim 1, wherein the maximum potential surface over  
the substrate is substantially flat.

1        17. A method of processing a substrate in a reactor system, the method  
2 comprising the steps of:

3 providing a processing chamber;

coupling power into the processing chamber to produce a plasma from which at least one product is used for processing the substrate;

6 providing a plasma shaping member within the processing chamber;

7 exposing the substrate to the at least one plasma product for processing.

1       18. The method of claim 17, further comprising the step of producing a plasma  
2       with an ion current density uniformity less than plus or minus 10 percent over the  
3       majority of the substrate for a processing chamber diameter less than 1.3 times the  
4       size of the substrate.

1 19. The method of claim 17, further comprising the step of producing a  
2 substantially flat maximum potential surface over the substrate.

1 20. The method of claim 17, further comprising the step of recombining positive  
2 ions and negatively charged species on a surface of the plasma shaping member.

1       21. The method of claim 17, further comprising the step of preventing high  
2 temperature electrons produced adjacent to the induction coil from diffusing toward  
3 the center of the processing chamber.